

WHAT IS CLAIMED IS:

1. A motor comprising : a stator, a rotor, and a plurality of phase coils which are energized successively for rotating the rotor, characterized in that
  - (1) one of the stator and the rotor includes a first surface which is opposed to  
5 the other of the stator and the rotor, the first surface being formed therein with a plurality of slots which are extended in the axial direction, which are circumferentially arranged along the first surface, and which accommodate the coils when the coils are wound, and a plurality of poles formed between two of the slots which are adjacent to each other,
  - 10 (2) the other of the stator and the rotor includes a second surface which opposes to one of the stator and the rotor, the second surface being provided thereon with a plurality of circumferentially arranged magnetic material pieces which are mutually independent of each other,
  - (3) the magnetic material pieces magnetically couples two adjacent poles,  
15 when the magnetic material pieces are opposed to two adjacent poles,
  - (4) a torque is produced by a magnetic flux generated in a closed circuit which is constituted by the two adjacent poles and the magnetic material piece placed therebetween, upon coil energization.
2. A motor comprising :
  - a first member;
  - a second member opposed to the first member;

one of the first member and the second member being made fixed, the  
5 other of the first member and the second member being made movable,

the first member having a first surface opposed to the second member,  
the second member having a second surface opposed to the first member, one  
of the first surface and the second surface being provided therein with at least  
a slot;

10 a coil provided in the slot;

a pair of members adjoin the slot constituting a pair of poles and in  
which a magnetic flux is generated between the pair of poles upon  
energization of the coil;

at least a magnetic material piece provided on the other of the first  
15 surface and the second surface, the magnetic material piece magnetically  
coupling, when being approached to the slot, both the poles adjacent the slot in  
order to constitute a closed magnetic circuit through which a magnetic flux  
passes which is generated between poles, the magnetic flux, when being  
changed, producing a displacing force relative to the magnetic material piece,  
20 thereby producing a force by which one of the first member and the second  
member is made movable relative to the other of the first member and the  
second member.

3. A motor as set forth in Claim 2, wherein the first member is of  
a cylindrical shape with an outer diameter, the second member is of a hollow  
cylindrical shape with an inner diameter which is larger than the outer

diameter of the first member in order to define a gap between the inner  
5 diameter of the second member and the outer diameter of the first member, the  
coils constitute a plurality of phase groups such that energizing the coils is  
made successively group-by-group.

4. A motor as set forth in Claim 1, wherein each of the coils is  
wound such that at least one of slots is placed between each of the coils, and  
each of the coils intersects with another coil.

5. A motor as set forth in Claim 3, wherein each of the coils is  
wound such that at least one of slots is placed between each of the coils, and  
each of the coils intersects with another coil.

6. A motor as set forth in Claim 1, wherein the poles are  
constructed such that wide poles and narrow poles are arranged alternately in  
the circumferential direction, circumferential width of the wide poles is wider  
than the circumferential width of the narrow poles, winding each of the coils is  
5 made in the axial direction such that the coil is accommodated in the slots  
adjacent to the wide pole.

7. A motor as set forth in Claim 2, wherein the poles are  
constructed such that wide poles and narrow poles are arranged alternately in  
the circumferential direction, circumferential width of the wide poles is wider  
than the circumferential width of the narrow poles, winding each of the coils is

5 made in the axial direction such that the coil is accommodated in the slots adjacent to the wide pole.

8. A motor as set forth in Claim 1, wherein the magnetic material piece is formed into a mountain shape which extends away from the opposing pole.

9. A motor as set forth in Claim 2, wherein the magnetic material piece is formed into a mountain shape which extends away front the opposing pole.

10. A motor as set forth in Claim 1, wherein the magnetic material piece is formed therein with a groove adjacent to the opposing pole.

11. A motor as set forth in Claim 2, wherein the magnetic material piece is formed therein with a groove adjacent to the opposing pole.

12. A motor as set forth in Claim 1, wherein the magnetic material piece is made larger than its opposing pole in circumferential width.

13. A motor as set forth in Claim 2, wherein the magnetic material piece is made larger than its opposing pole in circumferential width.

14. A motor comprising : a first member, a second member, one of the first member and the second member being used as a stator, the other of the first member and the second member being used as a rotor, the rotor being made rotatable relative to the stator, characterized in that

- 5 (1) the first member includes a first surface which opposes to the second member, the first surface being provided with a plurality of poles which are arranged in the circumferential direction along the first surface and which extend in the axial direction, the first surface being formed therein with a plurality of slots in such a manner that each of the slots is placed between the
- 10 poles which are adjacent to each other, two of the slots between which a plurality of other slots are placed are made to accommodate therein each of circumferentially arranged plural coils upon winding thereof which are to be grouped for constituting plural phases,
- (2) the second member includes a second surface which opposes to the first
- 15 member, the second surface being provided thereon with a plurality of circumferentially arranged magnetic material pieces which are magnetically independent with each other,
- (3) when the magnetic material piece is opposed to the plural poles which are consecutive in the circumferential direction, the consecutive poles are
- 20 magnetically coupled, the poles and the magnetic material piece constitute a closed magnetic circuit when each of the phases is energized to generate a magnetic flux, thereby producing a rotation torque,
- (4) in each of the grouped phases, different coils which are accommodated in the slots which are next to another are to be supplied with currents of same
- 25 polarity.

15. A motor as set forth in Claim 14, wherein ends of the coils which are different in phase intersect on the pole such that the coils accommodated in the slots which are next to another are made the same in current supply polarity.

16. A motor as set forth in Claim 14, wherein each of the phases is constituted by grouping the coils the number of which is even.